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OF THE

BAKALSKY DEPOSITS OF IRON

(SOUTH URAL)

BELONGING TO

MM. BALASCHEFF.

ST. PETERSBURG.
THE PRINTING OFFICE OF THE IMPERIAL ACADEMY OF SCIENCES.
V. O. 9th line № 12.
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$D_1^l g$. Sugar-like quartzy sandstone, and quartzites, shales of grey and black colour, containing subordinate lays of limestone, and passing in horizontal direction into micaceous quartzite and metamorphosed schists.

$D_1^l c$. Marble-like limestone with a rich Hercynian fauna, corresponding to the Bohemian horizon ***F***.

In the subdivision $D_1^l g$ all the principal iron mines of southern Ural are concentrated (amongst their number being the Bakalsky) inclosed between shales dipping under the quartzites and sandstones, which form all the prominent points in this part of the Ural mountains. As may be seen from the geological sections formed as much on account of the searching as of the mining works, the subdivision $D_1^l g$ represents, in the district of the Bakalsky iron deposits, the following horizons, descending from the top to the bottom.

a. Quartzites revealing themselves on the summits of the mounts Shuida, Bulandikha and Irkuscan.

b. Shales, bearing various colouring (light grey, yellowish and reddish grey, as also greenish grey) and containing inclosed grey, pretty often very ferruginous, dolomitic limestone of considerable thickness.

c. Quartzy shales, sericeous and black shales, forming the bottom of the Bakalsky series of sediments.

The veins of the rocks in question are crossed and intersected by dikes and stock-like masses of diabase, extending also in the manner of strata between the shales ***b***. These diabases, for the greater part, beeing metamorphosed have undergone some processes of hydrochemical and mechanical alteration. As may be seen in the profiles, the whole series of $D_1^l g$ is broken by many horizontal dis-

placements and faults rendering the regular exploitation of the ore extremely difficult.

Concerning the horizon and the form of the ore, it may be stated, that all are concentrated within the horizon *b*, representing a more or less thick layer, amounting in some places to a thickness of 40 and even 46 metres and nest-like masses.

On account of all the above facts, it seems evident, that iron ore is found in close connexion with dolomitic limestone, and that, thanks to processes of metamorphism, these limestones are transformed into spathic ore and afterwards into brown hematite. In the mineral beds in question, all the successive degrees of such a transformation may be observed.

In the beginning of the exploration of the Bakalsky deposits, when people were exclusively working on the surface, brown hematite was come upon; as the works were carried deeper, spathic iron ores were found, which gave place in their turn to dolomitic limestone. On several specimens of the collection illustrating the character of the Bakalsky rocks, it may be clearly observed, that the outside consists of spathic or brown hematite, whilst a kernel has been preserved, consisting of limestone, quite changed or only slightly altered. From all this it is evident, that at the Bakalsky mines, brown hematite and spathic ores serve as principal material; in some places, however, red hematite, of the red-ochre kind and specular iron-ore may be observed.

At present about 100,000 tons of iron-ore are yearly won at the Bakalsky mines, which are smelted into pig-iron in the following founderies: Simsky and Nicolaiewsky, belonging to Messieurs **Balascheff** in Katav-Ivanovsky

and Youresamsky, the property of the Prince Belosselsky-Belosersky, and in the foundery at Satkinsky, belonging to the state. The comparatively insignificant exploitation of the Bakalsky iron-deposits, considering their richness, is to be explained by the fact, that all the founderies in the southern Ural mountains use only charcoal for smelting purposes on account of the lack of mineral fuel. The whole of the Bakalsky ore deposit is devided into lots or shares, belonging to the owners of the above mentioned founderies. The share belonging to the Simsky foundery of Messieurs **Balascheff** has been minutely explored during the years 1890—92. During this time more than 1200 shafts for searching purposes were made, and four deep pit-holes were sunk, the deepest of which was carried to a depth of 70 metres.

The results of these searches, directed by the mining engineer Mr. A. Oehrn, form the principal subject of this short description.

In order to illustrate these results, we are going to exhibit: 1) A detailed geological map of the share belonging to Messieurs Balascheff's iron works, 2) a characteristic section across the whole extent of the veins of the ore deposits, following the direction of the lines, marked by letters on the map, and 3) a collection of specimens of the principal ores and the rocks, accompanying them, and marked on the section with the same numbres as in the collection.

Before describing the geological map in particular, it may be useful to make oneself acquainted with the section, of which there are three: the 1st across mount Bulandikha, the 2nd across mount Irkuscan, and the 3rd across mount Shuida.

On table II fig. 1 is represented the section through mount Bulandikha after the lines *EEE* (by the plan of table III) intersecting the mountain across the vein of the strata. Beginning at the northwestern point of this line we meet with the following rocks:

a. № 1 quartzite of the top NW 282° < 65°.

b. № 2 brown hematite and spathic ore from the stratum, exploited by the Bakalsky mines NW 282° < 55°.

№ 3 limestone from the bottom of the ore deposit NW 285° < 45°.

c. № 4 black sericeous shales, whose thickness is dipping NW 285° < 40°.

№ 5 shales № 4, apparently metamorphosed in contact with diabase № 6.

№ 6 diabase.

№ 7 shales № 8.

№ 8 black sericeous shales NW 285° < 35°.

№ 9 shaly limestone, overlying in places (all the lines of the section) the black sericeous schists NW 290° < 18°—45°.

№ 10, № 11 } black sericeous schists NW 282° < 18°—25°.

№ 12 siliceous shales.

№ 13 black sericeous shales SE 120° < 8°—35°.

b. № 14 ferruginous dolomitic limestone SE 120° < 40°.

№ 15 black sericeous shales.

№ 16 limestone SE 120° < 34°.

№ 17 ferruginous shaly limestone from the strata SE 110° < 34°.

b. № 32 ferruginous shales
№ 33 shaly brown hematite.
№ 34 shales.
№ 35 brown hematite.
№ 36 shaly brown hematite.
№ 37 brown hematite.
№ 38 ferruginous shales.
№ 39 shaly brown hematite.
№ 40 shales.
№ 41 brown hematite.
№ 42 shales.
№ 43 shaly brown hematite.
№ 44 shales.
№ 45 brown hematite.
№ 46 shales.
№ 47 brown hematite.
№ 48 shales.
№ 49 brown and red hematite forming the mightiest of all the strata NW 300° < 35°, exploited by the Tiazheley mine № 1.

The specimens 24—49 are taken from the group of strata and interstrata, dipping NW 300°—325° < 30°—35°.

c. № 50 quartzy shales NW 300°<35°, representing the bottom of the subdivision.
№ 51 dolomitic limestone forming the continuation of the vein of ore deposits № 49.
№ 52 diabase forming a dike, stretching from South-West to North-East.
№ 53 dolomitic limestone forming a large mass inclosed in the vein of the strata № 49.

№ 54 } quartzy shales, forming the summit of mount
№ 55 } Irkuscan.

Section across mount Shuida by the lines *yyy* ***T*** II and III.

In the direction from West to East the following rocks are to be met with:

a. № 1 quartzite NW 300° < 55°.

b. № 2 shales forming an accumulation, inclosed between quartzite-like schists NW 295° < 18° —40°.

№ 3 strongly altered diabase.

№ 4 shales from the top of the ore strata №№ 5—9. NW 302° < 40°.

№ 5 brown hematite with red hematite.

№ 6 red hematite with ferruginous mica.

№ 7 spathic ore.

№ 8 Crystalline limestone.

№ 9 limestone somewhat altered into spathic ore.

The specimens №№ 5 till 9 are taken from the iron deposits, NW 300° < 40°, exploited by the Uspensky mine № 3.

№ 10 banded shaly limestone from the bottom of the iron-deposits.

№ 11 altered diabase.

Fault.

№ 12 diabase outcropping in the direction of the fault.

№ 13 limestone, to be met with on the north side of the Uspensky mine № 2 on the vein of the stratum of brown hematite.

№ 14 brown hematite mixed with ochrey clay, form the iron deposits, expanding in a south-westerly direction.

b. № 15 clay, lying in irregularly stratified masses between the ore-deposit № 14.

№ 16 quartzy shales from the bottom of bed № 14 NW 295° < 8°—20°.

Comparing the three above mentioned sections across the mounts Bulandikha, Irkuscan and Shuida, the following general lines may be observed:

1) the ore is subordinated to limestones, and is inclosed between shales.
2) the horizon of iron-deposits has quartzites for its top.
3) as bottom quartzy (and sericous) shales are noticed. By these facts it is seen, that all the ore beds of the Bakalsky mines belong to the same subdivision of the lower Devonian.

Outcrops of the strata of the horizon of ironstone $D_1^1 g$ have been shown on the detailed geological map of the district belonging to the Simsky iron-works, where they correspond exactly to the numbers of shafts on every indicated spot.

On the north-eastern end of mount Shuida, where the Uspensky mines are situated, the top quartzites have been denudated, in consequence the strata of the iron-ore horizons *b* and *c* are here outcropping.

The north-western slope of the mountain consists of slates and siliceous shales *sh. sh.* dipping in accordance with the slope of the mountain at an angle of 18° to 40°, and dipping under the quartzites *k k* in a northern direction. Next to the passage of mount Shuida, the thickness of these schists is limited by a narrow outcrop of a strongly altered diabase *d d*. South by east of these diabases, beds of spathic ore *se se* are cropping out, which are exploited by the Uspensky mines № 3, dipping under the angle 40°;

these shales are covered on the top by a narrow outcrop of shales *t t.* The limestones *ca ca*, forming large outcrops, serve as a north-western continuation of these beds of spathic iron-ore. West by south to the Uspensky mine № 3 the ore bed is cleaving out as a kind of narrow bed of brown hematite *be be.*

Within the strata of spathic ore, which is transformed near the surface into brown or red hematite, blocks of limestone may be found on some spots. These blocks of limestone are very slightly or even not at all altered, and are accompanied by ochreous soft clay. To the south-west the layers of spathic ore and limestones are limited by a mighty outcrop of diabase *d d;* another bed of brown hematite is following it, and exploited (near the line of section *Y Y)* by the Uspensky mine № 2. This ore bed soon disappears towards the north-east, in its place the limestones *ca ca* are substituted, but it enlargens towards the south-west, forming here one of the richest ore-beds, exploited by the Uspensky mine № 1.

Shales seem to form the bottom of this bed, containing interstratifications of shaly sandstone, and forming outcrops *ts ts.* Another not very considerable bed of ore, representing most probably a horizontal displacement of the principal ore deposit, is subordinated to these latter schists. Still further to the south-east the quartzites *k k* appear and dip off like the quartzites of the south-eastern slope of mount Bulandikha; with those they are also united.

It seems very probable that the ore-bed exploited by the Uspensky mines №№ 1 and 2 represents part of a horizontal displacement of the spathic ore in the Uspensky mine № 3.

On the north-western slope of mount Bulandikka a mighty stratum of brown hematite *бб*, appearing from under the quartzites of the top *g g*, is exploited by the Bakalsky mines. Stretching to a distance of 560 metres from the line of section *ББ T* III to the north-east, the orebed disappears within the limits of the district belonging to the Simsky iron-works; searches made in the opposite direction having proved the presence of outcrops of iron-ore at a distance of more than 600 metres. The thickness of the ore-bed in the Bakalsky mine amounts to 50 metres. In this district of the Satkinsky iron-works of the state, the sunk pit-hole, passing all the time across the ore, has not yet, at the depth of 50 metres, reached the bottom of the ore-bed, apparently consisting of shaly limestone *b b;* this shaly limestone reposes in its turn on banded quartzy (sericeous) shales *i i* of very fine grain and of a nearly black colour. The whole passage of the mountain along the line of section *ББ* consists of these shales. The shales *sk sk* (№ 9) cover in some places these black shales *si si* (№№ 8, 9, 10, after the line *ББ).*

The whole thickness of the black sericeous shales *si si* is cut along the stretch of the vein by two outcrops of diabase, forming the bands *di di* and di_1 di_1.

The sericeous shales appear to be modified *si si*, next to these outcrops, like the specimens of the collection №№ 5, 7, 12.

On the eastern slope of mount Bulandikha the limestone *ks ks (T* II № 14) lies on the sericeous shales. Parallel to it an outcrop of black shales is striking *rr (T* II № 15); on it a bed of limestone *pp (T* II № 16) is lying, forming a wall, which extends from south-west to north-east. A mighty stratum of brown hematite *br br* is subor-

dinated to this limestone-bed, and exploited by the Bulandinsky mines.

The thickness of the ore-bed amounts to 40 metres, and its outcrops enlargen from the south-east to the north-west to the extent of 800 metres, cleaving out on both sides. At the point *mm* an insignificant stock-like bed of brown hematite may be observed in the mass of the limestone *pp*; the top of the Bulandinsky ore-bed consists of quartzites, forming high dikes on the south-west side of mount Bulandikha, and filling up the valley between this mountain and mount Irkuscan.

The ore-bed of mount Irkuscan is exploited on the north-west slope by the Tiajoly and Verhny Bulansky mines, but on the south-east slope by the Alexandrowsky, Ivanowsky and Okhreny mines. The top quartzites are washed out at the summit of the mountain, and form on both slopes ranges, which meet on the south-west side of the mountain.

All along the section *AA* (*T* III) the following transformations of rocks may be observed in the direction north-west to south-east: a bed of spathic ore *sp sp* crops out from under the quartzites, attaining in the mine *G* a thickness of 25 metres. Gradually getting narrow towards the south, this layer disappears at a distance of 160 metres from the line *aa*. On the opposite side, the layer enlargens and transforms itself at a distance of 180 metres (from the line *AA*) into dolomitic limestone *ll* representing in this manner a continuation of the ore-layer. Under the ore-layer is inclosed yellowish grey, greenish shales *qq*; the latter reposes again on a layer of dolomitic limestone *oo*. On the spot marked *uu*, this ore-bed transforms itself, through the whole thickness into spathic ore. Under the dolomitic

limestones *u u* lies an accumulation of greenish-grey shales *cl cl*, whose outcrops form a large wall striking over the whole slope of the mountain.

A whole row of ore-layers are subordinated to these very considerable shales *cl cl*, the former being exploited by the mine lettre *Th*. It is to be noticed, that in this pit the ore-beds are crossed by a vein of a very much altered diabase *db db*. The outcrops of these diabases stretch from north-east to south-west. On both sides of the line *A A*, the outcrops of the ore-deposits, lettre *Th*, soon disappear and change into limestone.

North of the line *AA*, near to the outcrop of the diabase *db db*, a rich ore-layer is situated, and exploited by the Tiajoly mine № 2. This ore-bed is supposed to represent the continuation of the ore-strata *sp sp*, dipping under the quartzites. The ore-strata here the eastwing of an anticlinical fold, like a small hillock, pointious to the north from the Tiajoly mine № 2. The remnants of top quartzites, on the spot marked *kw kw* may also serve as a confirmation of this hypothesis. Dolomitic limestone and shales crop out on the hillock in question, representing the continuation of the above mentioned outcrops of rocks: *l*, *l*, *qq*, *oo*, *cl cl*.

In the Tiajoly mine № 2 the regular stratification of the beds is very much altered by local folds and faults. Towards the south-west, the outcrops of ore-beds of the Tiajoly mine № 2 cleave out near the line of the section *A A*, and are replaced by a stratum of grey shales *gr gr*. A row of ore strata, exploited by the Tiajoly mine № 1, is subordinated to these shales; the layer consists of 12 strata and interstrata, interstratified by light yellowish grey shales (*T* II fig. 3 №№ 21—49). In the deep pit of the Tiajoly mine № 1, where the vein intersects the strata,

two faults have been observed, passing across the layer like inclosure of diabase between the strata №№ 25 and 27 (*T* II fig. 3). The average thickness of this layer amounts to 57 metres.

In the Tiajoly mine № 1 the transformation of limestone into ore may be very well observed; the north-east side of the mine in particular has already been completely exploited; here the place of the ore-bed is occupied by an equivalent number of strata and interstrata of limestone.

In the direction south by east the ore strata stretch to the very end of the mountain, where they dip under quartzites, next to which, the iron-deposits are in some places interrupted by thick layers of limestone. At the north-west end of the mountain spathic ores predominate, which are here exploited by the Verhny-Bulansky mine. The thickest and richest of all these last mentioned strata, seems to be the very lowest (*T* II fig. 3 № 49) which consists of brown hematite, and a subordinated quantity of red hematite, forming very fine stalactitic shapes. This layer forms between the Tiajoly and Verhny-Bulansky mines a very large outcrop *bg bg*, which thanks to two parallel faults, stretches nearly to the summit of the mountain; but in this part of the mine the ore is found in subordinated quantity, in stocklike masses, between the strata of limestone.

In one of the above mentioned faults, the diabase *dbz*, *dbz* crops out; these outcrops extend in a narrow stripe from the south-west end of the mountain towards the south-east. Quartzy shales *kt kt* form the bottom of the ore-horizon of mount Irkusean, constituting the summit of the south-west part of this mountain; they extend also towards the north-west slope of the mountain at a consi-

derable distance. Black shales also crop out from under the quartzy shales, in the spots marked *bl*, *bl* and bl_1, bl_1.

Parallel to the outcrops of the quartzy shales *kt*, *kt*, the outcrops of limestone *h h* and $h_1 h_1$ forming the top of the former, stretch out, but contain no iron-ore inclosures. In general, north and east of the Tiajoly mines, the ore disappears, and in its stead limestones, subordinated to shales crop out.

The boundary between the shares of the Simsky and the Katavsky mines, passes along the ridge of mount Irkuscan. On the south-east slope, belonging to the Katavsky iron-works, careful searching-works have not been undertaken, but thanks to the mining-works and natural denudations, the following idea of the formation of that part of the mountain has been obtained: In the direction south by west to the north-east, two parallel ranges of high ridges of quartzites *kw* I and *kw* II stretch, washed out in some places, and representing a horizontal dislocation of the same stratum. Under the first outcrop of the quartzites *kw* I a bed of brown hematite lies, exploited by the Alexandrowsky mine. In the direction east by north, this ore-bed is transformed into limestones; the latter still contains, within the limits of the Katavsky share, several stock-like deposits of brown hematite. Under the second range of the outcrop of quartzites *kw* II, lies an iron ore-bed, exploited by the Okhreny and Ivanowsky mines. These ore-beds, being also subordinated to the limestone, stretch towards the north-east end of the mountain, where they are exploited as spathic ore by the Yelnichny mine, belonging to the Satkinsky iron-works of the state.

The bottom of these ore deposits consists of shales. In

comparing now the conditions of the laying of the strata, constituting the Bakalsky ironstone deposits, taking also into consideration all that has been said above, whilst examining the geological sections, about the analogies in the order of the stratifications, we come to the following conclusions:

Mount Bulandikka and mount Irkuscan represent two antielinal folds, nearly parallel to one another, of the same group of deposits, the wings of which meet in the longitudinal valley of the brook „Bulanka“, in the manner of a synclinal fold. The ideas stated in section (*T* II fig. 1) have been formed in consequence the above conformities. The supposition seems to be very probable, that the mineral beds of the Uspensky mine represent a continuation of the ore-beds of the Bakalsky mine, following in the direction of the vein and being in a horizontal dislocation directed westwards. As to the depth of the deposits in the Bakalsky mineral layer, one can admit, considering the mining works which have been undertaken and the pits that have been sunk, that to a depth of 70 metres, the ore-strata do not change in their composition.

If we now try to calculate the quantity of ore, which may be won by open pits, founding our estimate on the map of outcrops and on the numerous profiles, we come to the conclusion, that the ores contained within the limits of the share, belonging to the Simsky iron-works amount to no less than 16,000,000 tons.

This supposition is founded on a series of trials, which show, that every cubic metre contains pure ore, according to the quantity of mixtures in the layer, from 11,5 tons to 33 tons.

In calculating the richness of the ironstone deposits of the neighbouring shares belonging to the Satkinsky, Katavsky and Youresansky iron-works, it may be admitted, that the amount of ore therein will not be less, than the above mentioned quantity. The winning of ore is produced, at all the mines in open pits by means of terraces, whose height varies from 2 till 4 metres, according to the compactness of the rock. For solid rock-work gelatinous-dynamite is used. The cartius away is done partly by rail (system Decoville) and partly by two-wheel carts, drawn by horses.

The ores are sifted through iron grates in order to remove the clay and the earthy substances on the place of exploitation. Here also the ore is very carefully roasted in big open heaps (up to 8000 tons in a heap) under cover of earthy ore.

By this process 3 tons of well roasted ore are obtained, on every cubic metre of birchwood. The roasted ore is once more sifted before it is transported; the whole loss in weight by roasting and sifting amounts to about 20%.

The iron-works being at a distance of about 100 kilometres from the mines, the roasting of the ore on the spot, by lessenning the weight, considerably reduces the cost of transport. The transport of ore goes on only in winter and is done partly by sledges, drawn by horses, and partly by the Samaro-Zlatoust Railway Company.

The exploitation of the share belonging to the Simsky iron-works is going on in the following mines:

On mount „Irkuscan“:

1) Tiajoly mine № 1.
2) Tiajoly mine № 2.
3) Verhny Bulansky mine.

On mount „Bulandikha“:

4) Bulandinsky mine.

5) Bakalsky mine (of the Simsky share).

On mount „Shuida“:

6) Uspensky mine № 1.

7) Uspensky mine № 2.

8) Uspensky mine № 3.

For the valuation of the qualities of the ores, the following analysis may serve:

Denomination of the ores.	SiO_2	Al_2O_3	Fe_2O_3	Fe	MnO	CaO	MgO	P	S	Volatile substances.
1. Red hematite, not roasted, from the Tiajoly mine № 1	1,30	0,36	90,00	63,00	1,93	1,20	0,09	0,011	—	4,80
2. Brown hematite, not roasted, from the Tiajoly mine № 1	1,29	0,51	89,69	62,78	1,84	1,11	0,13	0,009	—	5,00
3. General standard of roasted ore out of the Tiajoly mine № 1 . . .	3,88	3,12	88,34	61,84	1,12	1,50	traces	0,03	0,05	2,32
4. General standard of roasted ore out of the Tiajoly mine № 2 . . .	7,62	5,08	82,40	57,68	1,50	1,36	0,08	0,03	0,04	2,31
5. General standard of roasted ore out of the Verhny Bulansky mine .	4,28	4,56	84,86	58,98	2,54	2,12	0,75	0,042	traces	1,70
6. Brown hematite of roasted ores from the Bulansky mine	10,18	3,88	85,27	59,69	0,41	0,46	0,22	—	traces	0,64

Denomination of the ores	SiO_2	Al_2O_3	Fe_2O_3	Fe	MnO	CaO	MgO	P	S	Volatile substances.
7. General standard of roasted ore from the Uspensky mine № 2 . .	3,90	2,22	89,38	62,51	1,44	0,91	0,09	0,012	—	2,41
8. General standard of roasted spathic ore from the Uspensky mine № 3	6,40	2,58	85,63	59,88	1,78	1,54	0,05	0,014	—	2,11

At the Simsky and Nicolaievsky founderies flux-sand of the following composition is used in order to smelt pig-iron:

Denomination.	SiO_2	Al_2O_3	Fe_2O_3	$CaCO_3$	$MgCO_3$	P	S
Flux-sand of the Simsky foundery	2,86	4,88	1,16	81,46	10,16	traces	traces
Flux-sand of the Nicolaievsky foundery . .	3,10	5,12	1,44	67,25	23,29	traces	traces

With these flux-sands, a scoria of the following composition is obtained;

Denomination of scoria.	SiO_2	Al_2O_3	FeO	MnO	CaO	MgO	P	S	Relation of the silica oxygen to the basis ox.
a) Scoria of white pig-iron from the hot blast-furnace of the Simsky foundery . .	50,86	18,64	3,92	5,44	17,32	3,41	traces	traces	1,53
b) Scoria of gray pig-iron from the hot blast-furnace of the Simsky foundery .	48,82	19,10	1,52	3,48	22,86	3,81	traces	traces	1,44

The pig-iron is smelted in three hot blast-furnaces (of circled section) of the Simsky and Nicolaiewsky founderies of Messieurs Balascheff; at the Minyarsky iron-works, also belonging to them, the pig-iron is worked in puddling furnaces into soft-iron, which is rolled there into merchant-iron and sheet-iron.

Analyses of pig-iron and puddled-iron:

Denomination of pig- and puddled-iron.	C combined	C Graphitic	Si	Scoria	Mn	P	S
White pig-iron from the hot blast-furnace at the Simsky foundery (with the scoria *a*).	2,986	0,704	0,511	—	0,60	0,07	traces
Gray pig-iron from the hot blast-furnace of the Simsky foundery (with the scoria *b*).	0,545	3,815	1,07	—	1,12	0,068	traces

Denomination of pig- and puddled-iron.	C combined	C Graphitic	Si	Scoria	Mn	P	S
White pig-iron of the Simsky foundery	3,80	0,44	0,20	—	1,26	0,045	traces
Gray pig-iron of the Simsky foundery	0,66	3,80	1,38	—	1,59	0,06	traces
A bar of puddled iron from the Simsky foundery	0,20	trac.	0,062	0,058	0,19	0,028	traces

Manager of the mines belonging to the Simsky iron-works of Messieurs **Balascheff**

Mining Engineer Ad. Oehrn.